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This report presents the initial investigation of a longitudinal research effort to study various factors related to current development. The value of this study is its potential value in increasing the understanding of circumstances under which certain behaviors occur. In particular, this study has attempted to evaluate the usefulness of the General Aptitude Test Battery (GATB) in providing valid information to ninth grade students who are considering entrance into the senior high school vocational curriculum. The study was conducted using a sample of 92 10th grade boys in the 14 vocational shops of the Altoona area vocational-technical school. Based on the findings of this study, it appears that the GATB does provide useful information for the ninth grade student who is contemplating entrance into the senior high school vocational curriculum. Also, it can be hypothesized that the GATB is superior to other aptitude measures in predicting shop achievement because it contains manipulative as well as cognitive aptitudes. Its value to counselors may thus lie in its ability to assess youngsters' potential motor skill development. (CH)

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EXPLORING THE USE OF THE GATB WITH VOCATIONAL-TECHNICAL BOUND NINTH GRADE BOYS

JEROME T. KAPES

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EXPLORING THE USE OF THE GATB WITH VOCATIONAL-TECHNICAL BOUND NINTH GRADE BOYS

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SYN71797

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FOREWORD

This report represents the initial investigation of a longitudinal research effort to study various factors related to career development, designed and implemented in the Department of Vocational Education at The Pennsylvania State University. Within the larger framework of the programmatic effort, the study reported here by Jerome T. Kapes has been designed to uncover evidence regarding the potential contribution of the General Aptitude Test Battery.

The value of this study, as is envisioned for the whole longitudinal effort, lies not in its potential contribution to the more precise prediction of behavior. Rather, its potential value lies in increasing the understanding of the circumstances under which certain behaviors occur. The ultimate objective is the altering of those behaviors, when judged appropriate, given the initial understanding.

A number of staff members in the Department of Vocational Education, including several assigned to the Computer-Assisted Occupational Guidance project, have made significant contributions to the study. The Pennsylvania Bureau of Employment Security should be recognized for their assistance prior to and during the course of the study. Special thanks are also due to Dr. Thomas Long, Mr. Herbert Bolger, and other professional personnel on the Altoon School District staff whose cooperation was essential during the planning and data collection phases.

Joseph T. Impellitteri, Chairman
Graduate Studies and Research

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THE PROBLEM, RELATED STUDIES AND BACKGROUND

Stimulated by the Vocational Education Act of 1963, a tremendous growth has taken place in vocational-technical education throughout the nation. With the financial aid provided by this act, many of our states are investing large sums in new or expanded facilities and programs. In Pennsylvania millions of dollars are being spent each year on new physical facilities for vocational-technical education. Forty-seven program plans have been approved as of June 30, 1967. The figures in Table I have been taken from "A Program Report on Area Vocational-Technical School Developments to June, 30, 1967," and will help to show the magnitude of the building program.

Table I

Vocational-Technical School Building Construction Projects in Pennsylvania for the Years 1964 to 1968.

Fiscal Year	Total Cost of Projects
1964 - 1965	$11,088,432
1965 - 1966	15,824,965
1966 - 1967	51,006,706
1967 - 1968 (Projected)	96,674,812

The average pupil size of each of these new schools is 885, which represents an average of 17.9% of the total senior high school enrollment of the participating districts. The average number of course offerings in each school is 21. The type of courses offered range

from the technical level such as Computer Technology and Drafting and Design Technology to the skilled level such as Machine Shop and Trowel Trades. As these schools are completed, they will provide many opportunities for the high school student who is not planning to attend a four-year college to prepare himself for the world of work. The choices available to the student will be much more numerous and flexible than they were in the past.

Along with this increased opportunity provided by the new vocational-technical schools comes added responsibilities for the guidance counselor. It will be his job to provide each student with the information he needs to make the most of the choices available to him. The time of decision for most students will come in ninth grade when he must decide which course of study to follow in high school-- to prepare for college, to prepare for entry into the world of work, or perhaps to prepare for both alternatives. In order to make the most rational decision at this point, a student must understand: the nature and possible consequences of each alternative; his own strengthsand weaknesses, likes and dislikes; and the implications of what he knows about himself as they apply to choosing the most suitable alternative. For the counselor, helping the student to understand the alternatives is perhaps the easiest of the tasks at hand, but to stop here would be leaving most of the job undone.

There are many kinds of things the student should know about himself in order to plan wisely. He needs to understand himself in terms of his aptitudes, skills, knowledge, motivations, values, attitudes, and interests. Information necessary for the student to achieve some understanding of himself can be provided by examination of his cumulative record. This includes his grades in courses he has taken along with

other teacher evaluations. Evaluations by Industrial Arts teachers are often used for those students considering the vocational curriculum. In addition to these sources, tests which measure general scholastic aptitude, other general and specific aptitudes, achievement in specific areas, and interest are also used by many schools. Many of these tests have a long history of relatively successful use for providing information to aid counselors in guiding youth to self-understanding.

Even if one were to assume, however, that understanding of the alternatives and understanding of self has been achieved by the student with the aid of his counselor, is the task complete? There remains the problem of establishing a relationship between the two understandings prior to the act of choosing.

What, then, is the responsibility of the counselor at this final stage of one of the first of a series of such processes? Undoubtedly his primary responsibility is to avail himself of that information which will be most meaningful to the student when faced with the task of relating self to education and work.

The purpose of this study is to investigate the usefulness to the counselor of one of the many important kinds of information needed to perform the task--the validity of various aptitude measures administered in the ninth grade in predicting achievement in selected secondary level vocational and technical programs. The primary reason for focusing on the validity of aptitude measures at this time is the impending availability for use by qualified school personnel of the General Aptitude Test Battery (GATB).

The very practical decision of schools whether or not to adopt the procedure of administering the GATB to their ninth graders for

guidance purposes should be influenced by evidence of its predictive validity. Admittedly, the evidence uncovered by this investigation is not, nor should not be, conceived to be conclusive. Its values can only be measured in relation to the interest it may provoke in conducting other studies of its type and its contribution to the more inclusive body of knowledge which may result.

Review of Related Literature

The General Aptitude Test Battery (GATB) has had a long history of development and research involving the validation of its use for vocational counseling. Many of these studies were specifically designed to investigate its usefulness in predicting success on the job, others in predicting academic achievements, while some were designed to predict success in training situations. In order to get a comprehensive look at what has been done in the past, the reader is referred to the General Aptitude Test Battery, Section III: Development, U. S. Department of Labor, October, 1967. Some of the studies or articles cited there are pertinent to this investigation and are briefly reviewed here. Many other references may be found in the "Section III" publication, however, which have not been included in this review. The only references selected for mentionin this paper were those which either directly or indirectly pertained to the validity of the GATB when used with ninth grade students to predict success in a secondary level vocational or technical program.

Dvorak (1956) reported on the GATB in one of a series of articles describing various aspects of multifactor aptitude tests appearing in the Personnel and Guidance Journal (PGJ). Super, in his comments which followed at the end of Dvorak's article, pointed out what he felt were the weaknesses and strong points of the GATB and offered several suggestions

for its further improvement. Since that time much of what Super recommended has been accomplished and more recently Super has stated (Super and Crites, 1962):

> The first edition of this text was both enthusiastic about the promise of this battery and critical of the paucity of data made available in the manuals and in other publications to justify the battery's proposed use. In two revisions of the manuals and in a large number of journal articles, Dvorak and her collaborators have since provided the empirical evidence needed for the evaluation and use of the test battery; in their current form they are a model of completeness and of clarity.

Samuelson (1956) using a sample of 136 males over 16 years of age from the Area Vocational Schools in Salt Lake City, Utah, studied the GATB's use for predicting success of vocational school students in Auto Body, Auto Mechanics, Carpentry, Diesel Mechanics, Electronics and Welding. The criteria used were developed from instructors' ratings of performance in theory class, shop work and of personal characteristics. To establish the reliability of the ratings, students were evaluated at the end of ten weeks and again four weeks later. Reliability of ratings were reported as quite high. The three criteria, however, were found to be highly intercorrelated and were therefore combined.

It was arbitrarily decided to select a three aptitude composite to correlate with the criterion for each shop. The basis for their selection was: (1) The aptitudes had no common sub-test; (2) the first two aptitudes selected were those with the highest correlation with the criterion; and (3) the third aptitude was chosen on the basis of face validity and significant correlation with the criteria. Using this procedure, three aptitudes were selected for all but Auto Body for which only two were reported. Multiple correlations ranged from .508 to .827 within all shop areas, and were significant for all areas except Diesel Mechanics and Welding.

Culhane (1964) in a brief article describing the release of the GATB by the United States Employment Service (USES) and its subsequent use in schools, pointed out that as of 1964 the GATB had been released to 600 schools in 36 states. She also suggested in the article that at the ninth grade level the GATB should be used both to broaden occupational horizons and for making curricular choices.

Wysong (1965) has described some of the recent developments concerning the GATB and has also made some suggestions for its use in grades nine and ten. He described a procedure initiated by the Ohio State Department of Education for cooperating with the Ohio State Employment Service to make the GATB available for use in ninth and tenth grades. He went on to point out that the GATB obviously could not be used in the same manner with ninth and tenth grade students as it was used by the employment service. Possible ways were suggested in which the GATB could be used by school counselors in grades nine and ten. Wysong saw the need for interpretative materials which would enable the counselor to emphasize a "developmental guidance and counseling theme". "The use of the GATB in grades nine and ten should stress (1) self-understanding, (2) motivating and orienting, (3) discovering clues, and (4) exploring opportunities."

Droege (1965) reported on a study designed to investigate the extent to which occupational test norms validated on an adult sample would predict success of high school students in vocational courses. Norms developed in 1953 for compositors in the printing trade consisting of the aptitudes Intelligence (G), Verbal (V), Clerical Perception (Q), and Manual Dexterity (M) were used. The study was conducted in 1963 by the Indiana State Employment Service, and the sample consisted of 70 ninth grade

students. Instructors' ratings one year after entering the program were used as the criterion of success on a dichotomized basis of Good and Poor. The cutting scores were adjusted for maturation on the basis of previous research findings. The multiple correlation between the four aptitude scores based on the 1953 norms and the dichotomized criterion was .38, significant at the .01 level. Droege suggested further research of this nature.

Ingersoll and Peters (1966) investigated the use of the GATB to predict the grade point averages of freshmen and sophomores in academic and vocational classes in the Ohio secondary schools. The sample consisted of 4,000 ninth and tenth grade boys and girls. Multiple correlation, analyses were undertaken. Intelligence (G) correlated most highly (.60) with the criterion for the entire sample. Although many academic areas were studied, the only non-academic areas studied were Industrial Arts and Home Economics on the ninth grade level and Industrial Arts, Home Economics, Mechanical Drawing and Art on the tenth grade level. Several Business courses were also included. In most cases the GATB significantly predicted the criteria in the above mentioned non-academic courses. The composite of Form Perception (P) and Verbal Aptitude (V) correlated significantly with Mechanical Drawing success (.621). The authors also make the observation that few students in the sample studied were taking vocational and commercial courses and that they found very little literature concerning the use of the GATB in junior-senior high school.

Droege (1966) reported the results of a study on maturation to improve the usefulness of the GATB with high school students. The most significant findings were that stability coefficients increased from

ninth to eleventh grades. In ninth grade, stability coefficients were highest for General Intelligence (G), .79, Verbal aptitude (V), .79, and Numerical Aptitude (N), .77. The lowest stability coefficient was for Finger Dexterity (F), .57. The use of Occupational Aptitude Patterns (OAP's) with ninth grade students was questioned as a result of the low stability coefficients obtained. In order to partially overcome the problem it was recommended that cutting score bands equal to plus or minus one standard error of measurement be used in order to increase the stability of OAP's. When using OAP's with students in the lower high school grades, it was further recommended that interpretation be restricted to those individuals whose scores fall outside the band. More research of this nature can be found in Chapter 19 and 20 of the GATB manual "Section III" on development.

After a relatively exhaustive search of the published literature, the studies reported were the only investigations utilizing the GATB found to be related to the problem under examination in this paper. Because of the scarcity of pertinent evidence, it would be impossible to draw any decisive conclusions with reference to the value of the GATB in predicting secondary level vocational or technical program achievement.

Further investigation of the literature was undertaken in order to determine the predictive efficiency of the GATB as compared to another aptitude battery which enjoys widespread usage in the schools, the Differential Aptitude Test (DAT). Such comparable data is considered to be essential in adequately evaluating the potential use of the GATB for vocational counseling in the lower high school grades.

Stoughton (1955) studied the DAT in relation to differential prediction of various measures of success in Connecticut technical schools.

The sample included students in the ninth grade in ten Connecticut technical schools. The criteria of success were grade nine and grade eleven marks in both general education and shop subjects. Shops studied were Auto, Carpentry, Drafting, Electrical and Machine. The Verbal and Numerical scores of the DAT showed a high correlation with both general education and shop course grades. The clerical and spelling test showed little relationship for predicting success. The Abstract, Space, and Mechanical aptitude scores were more useful for predicting the shop criteria than they were for predicting general education success. Results of the study indicate that further research is necessary before the DAT can be used to make differential predictions of the probability of success in training programs.

Doppelt, Seashore and Odgers (1959) studied the usefulness of the DAT in predicting success for auto mechanics and machine shop students on the high school level. The sample consisted of 285 eleventh grade students in seven schools in Ohio. These students were tested again in twelfth grade. The criterion consisted of instructors' ratings on four traits. These traits were: (1) Understand Trade Information, (2) Job Know-How, (3) Quality of Work, and (4) Quantity of Work. Grades were not used because of the difficulties encountered in combining data from seven schools. Correlations were reported in tabular form between each trait and each aptitude test included in the DAT. The correlations were computed separately for each grade level and for each of the two shops studied. For Auto mechanics no outstanding high correlations were found. For machine shop, significant correlations were obtained. The best predictor of the combined criteria in machine shop was obtained by using the sum of the scores on three tests: Abstract Reasoning, Space Relations,

and Mechanical Reasoning. This combination yielded correlations of .52 for eleventh grade and .53 for twelfth grade machine shop students. For maximum usefulness, it was suggested that the data obtained from the machine shop sample be converted to expectancy tables.

Foote (1960) studied the prediction of success in a secondary school program of auto mechanics using verbal and non-verbal I.Q., three mechanical aptitudes, an arithmetic and reading test and the Kuder. The sample consisted of 435 beginning students. Two dichotomous and ten continuous criteria were used as a measure of success. It was found that the arithmetic test, DAT Mechanical Reasoning, SRA Mechanical Aptitudes (Spatial Relations and Mechanical Knowledge parts) and the Kuder Persuasive scale were significant predictors of graduation, continuation in the program, performance test scores and related subjects grades. Shop grade averages were the most poorly predicted criterion with a multiple R of .25 over the three year period obtained from the arithmetic test and the DAT Mechanical Reasoning test.

In summary, the research and other articles briefly reviewed here tell only part of the story of what has been done in the past. The much larger task undertaken by the employment service and numerous other individuals to investigate the validity of the GATB for use in vocational counseling (reported in the Section III volume) is monumental and stands as a tribute to their efforts. However, there is still much to be done. With the GATB now available for use with students in the lower high school grades many new opportunities for needed research present themselves. The most likely place to conduct much of this research is in the area of vocational-technical education. It is obviously essential to gather as much evidence as possible at this time to demonstrate the relative

effectiveness of the GATB for school use. The purpose of this study is to conduct the first phase of a longitudinal effort designed to reveal pertinent data.

Background of the GATB

Since this study was conducted to uncover evidence which may be used by guidance personnel in the schools, a brief description of the GATB will be presented at this point. Although many school counselors have some information pertaining to the GATB, few have had the opportunity either to administer the test or to interpret the resulting scores. The material presented in this section has been included to help the school counselor understand the potential uses of the GATB with ninth graders.

The GATB is not a new test. It was first released by the USES in 1947 for use in employment counseling (primarily with adults). The first edition of the GATB (B-1001) contained 15 sub-tests and was designed to measure 10 aptitudes. As an outgrowth of research findings based on the first edition an improved version (B-1002) was released in 1952, which contained 12 sub-tests and was designed to measure 9 aptitudes. In the revised edition, several sub-tests which were found to contribute an insignificant amount to the measurement of certain aptitudes were dropped in order to reduce administration time. As a result of their elimination, Aptitude Aiming or Eye-Hand Coordination (A) and Motor Speed (T) were combined to form the aptitude Motor Coordination (K) which is based on only one sub-test. The revised edition is made up of 8 paper-and-pencil sub-tests and 4 apparatus sub-tests. Seven of the paper-and-pencil sub-tests can be machine scored. The entire battery takes about two and one quarter hours to administer. The revised

battery currently in use has been designed to measure the following aptitudes:

G - Intelligence--General learnings ability. The ability to "catch on" or understand instructions and underlying principles; the ability to reason and make judgements. Closely related to doing well in school.

V - Verbal Aptitude--The ability to understand meaning of words and to use them effectively. The ability to comprehend language, to understand relationships between words and to understand meanings of whole sentences and paragraphs.

N - Numerical Aptitude--Ability to perform arithmetic operations quickly and accurately.

S - Spatial Aptitude--Ability to think visually of geometric forms and to comprehend the two-dimensional representation of three-dimensional objects. The ability to recognize the relationships resulting from the movement of objects in space.

P - Form Perception--Ability to perceive pertinent detail in objects or in pictorial or graphic material. Ability to make visual comparisons and discriminations and see slight differences in shapes and shadings of figures and widths and lengths of lines.

Q - Clerical Perception--Ability to perceive pertinent detail in verbal or tabular material. Ability to observe differences in copy, to proofread words and numbers, and to avoid perceptual errors in arithmetic computation.

K - Motor Coordination--Ability to coordinate eyes and hands or fingers rapidly and accurately in making precise movements with speed. Ability to make a movement response accurately and swiftly.

F - Finger Dexterity--Ability to move the fingers, and manipulate small objects with the fingers, rapidly or accurately.

M - Manual Dexterity--Ability to move the hands easily and skillfully. Ability to work with the hands in placing and turning motions.

Raw scores from the test are converted to standard scores which have a mean of 100 and a standard deviation of 20 based on adult norms. In 1959 norms were first released for ninth and tenth grade. On the basis of data collected since that time and on maturation studies by Droege (1966)

new normative information for ninth and tenth grade was released in 1966.

Occupations which require similar aptitudes have been grouped together to form Occupational Aptitude Patterns (OAP's). Each OAP consists of three of the nine aptitudes found to be significant for that family of occupations. The three significant aptitudes are reported in terms of cut-off scores, the minimum scores found to be essential to successful performance in the occupation. The most recent publication of norm data was released in June, 1966, and included 36 OAP's which covered over 850 occupations. For each OAP there are reported not only adult norms bur norms for grade nine and grade ten as well. Droege (1966) points out that OAP's for both ninth and tenth grades should be used with cutting score bands equal to plus or minus one standard error of measurement. In addition, he suggests that interpretation should be restricted to those individuals whose scores fall outside the band when using OAP's with students from the lower high school grades.

Until recently the USES completely controlled the administration of the GATB. When the test was given to secondary school students, it was administered by a qualified employment service representative. With the development of ninth and tenth grade norms and increased interest on the part of the schools the USES established a policy that the senior state officers in each state may release the GATB Form-B-1002 to secondary schools. It is in the light of this new policy that this study was undertaken.

Statement of the Problem

The specific purpose of this study was to compare the validity of

the GATB to the validity of the aptitude measures currently used in Altoona, Pennsylvania in predicting first semester shop grades for a sample of tenth grade boys. The aptitude measures currently used in Altoona for counseling ninth grade boys who are anticipating their entrance into the senior high school vocational program are the Academic Promise Test (APT) and the language part of the California Test of Mental Maturity (CTMM). Because of the small number of students from the selected sample enrolled in each shop area it was necessary to combine several shops together to form three groupings or levels. Working within this framework the following questions were formulated:

1. For each of the three groupings (Level I, II and III) and for the total sample:

   a. What is the validity of the GATB for predicting achievement as compared to the validity of the composite (APT-CTMM) now being used?

   b. Does the use of the GATB manipulative aptitudes (K, F and M) as predictors increase the validity of the GATB?

   c. Does the use of the two predictor composits combined (APT-CTMM and GATB) result in an increase in predictive efficiency as compared to using the measures separately?

2. What effect does combining the three groupings (Level I, II and III) have on the validity of both the GATB and the composite APT-CTMM in predicting achievement?

PROCEDURE

Subjects

The sample for this study consisted of male students in the tenth grade enrolled in the Altoona Area Vocational-Technical School. Test data was gathered during the previous two years when the students were attending Keith Junior High School in Altoona. In September, 1965, as

eighth graders, all of the students in the school received the language part of the California Test of Mental Maturity (CTMM). In December of the following year when these same students were in ninth grade they were given the Academic Promise Test (APT). In addition to the CTMM and the APT, those students who expressed an interest in enrolling in the vocational curriculum in high school were given the GATB form B-1002 in April of their ninth grade year. The number of students tested with the GATB at that time was 112. At the time the criterion was obtained, which was at the end of the first semester of the tenth grade year, 92 students with complete data remained in the sample. Of the 20 students lost, approximately half were not enrolled in the vocational curriculum and the remainder were lost due to incomplete data. This sample of 92 students comprised approximately one-fourth of the total number of tenth grade students enrolled in the vocational curriculum in Altoona.

There were 14 different vocational shops in which the 92 students were enrolled, but because the number of students from the sample in each shop was small it was necessary to group several shops together. This was done in such a way as to obtain the maximum homogeniety within each group while achieving a sufficiently large sample size. Three levels were decided upon and included the following shops: Level I (N=22) - Computer Technology and Drafting and Design Technology; Level II (N=35) - Auto Mechanics, Electricity, Machine and Printing; Level III (N=35) - Auto Body, Carpentry, Home Appliance Repair, Planing Mill, Plumbing, Sheet Metal, Trowel Trades and Welding. The percentile equivalents of the individual GATB aptitude scores for each level are given in table II.

TABLE II

Percentile Equivalents of Mean GATB Scores Based on 9th-Grade Norms*

	Aptitudes								
Level	G	V	N	S	P	Q	K	F	M
I N = 22	68	50	74	71	80	64	71	62	71
II N = 35	46	42	53	49	55	48	50	41	50
III N = 35	46	41	54	48	52	50	47	41	46
Total N = 92	50	44	58	54	60	53	54	46	53

*Percentile equivalents are approximations based on Table III of the Manual for the General Aptitude Test Battery, Section II: Norms.

Criterion

Course grades assigned by the shop instructor at the end of the first semester were selected as the criterion for this study. Grades were assigned on a 5 point scale with an "A" worth 5 points and "F" worth 1 point. As has been previously indicated, it was necessary to combine several shops in order to obtain sufficient sample size for analysis. In order to eliminate differences among teachers' grading systems within a grouping formed by combining several shops, standard scores with a mean of 500 and a standard deviation of 100 were used. The number of students included in the 14 shop areas ranged from 12 to 57 with an average of 25 students per shop. The following rationale was used as a basis for converting the grades of each of the 92 students in the sample to standard scores.

The necessary characteristic of achievement measured by grades is that a particular grade such as "C" obtained by one member of the sample is equivalent to a "C" obtained by another member of the sample. Since the shops were grouped to attain a sufficiently large sample size this characteristic was lost. (The "C" obtained by a student in shop X might have been the lowest grade given by the instructor in shop X, whereas the "C" obtained by a student in shop Y might have been at the median of the distribution of grades given by the instructor in shop Y.) In convertingto a standard score distribution, information about the actual grade received by a student was given up so that equivalency of the achievement measured could be attained. (The score of 500 attained by a students in shop X is considered to be the equivalent of a score of 500 attained by a student in shop Y relative to each of the student's standing in his shop area).

Analysis

Multiple regression analysis was used for each of 12 separate sub-problems. The 12 sub-problems conisted of an analysis of each of the four groupings (Level I, II, III and the entire sample) for the GATB composite alone, the APT-CTMM composite alone and for the composites combined (GATB and CTMM). Multiple regression was carried out using the procedure of elimination of variables by parsimony. This method compares the amount of predictable variance using a composite composed of all predictors less one (the least contributing predictor). If a non-significant loss of predictable variances occurs, the new composite is compared to a succeeding one in which two variables (the two least contributing predictors) are eliminated. Predictors are eliminated one by one until either only one remains, or a significant loss in prediction occurs.

From the results of previous research it was hypothesized in this study that utilizing the .01 level of significance as the criterion for reducing the size of the prediction composite would result in the elimination of all but one of the predictor variables for each of the sub-problems. For the purposes of this study, then, significant findings would be reported in terms of a number of zero-order correlations in addition to multiple correlations. If this, in fact, was the case it would then be possible to investigate the effect of sample size on question #2--the comparison between predicting achievement within levels and predicting combined achievement of the total sample.

The technique utilized in determining the effect of sample size (a reflection of the representativeness of the sample statistic to the population parameter ρ (rho) is to calculate 95% confidence intervals for the zero-order correlations using Fisher's z-transformation. The resulting ranges could then be examined for amount of overlap.

RESULTS

The results of this study are reported here in terms of the following questions posed in the statement of the problem.

Question #1 - For each of the three groupings (Level I, II and III and for the total sample:

Part a - What is the validity of the GATB for predicting achievement as compared to the validity of the composite (APT-CTMM) now being used?

Part b - Does the use of the GATB manipulative aptitudes (K, F and M) as predictors increase the validity of the GATB?

Part c - Does the use of the two predictor composites combined (APT-CTMM and GATB) result in an increase in predictive efficiency as compared to using the measure separately?

Question #2 - What effect does combining the three groupings (Level I, II and III) have on the validity of both the GATB and the composite APT-CTMM in predicting achievement?

Question # 1 - Part a

What is the validity of the GATB for predicting achievement as compared to the validity of the composite (APT-CTMM) now being used?

Table III for the GATB, and table IV for the APT-CTMM show the multiple R's between each of the composites and course grades at each iteration in the parsimony program for all four groupings. Zero-order correlations with the most significant predictor appears at the bottom of each table. Comparing the two composites using all of the predictors in each composite, the multiple R's for the GATB are as follows: Level I, .69; Level II, .64; Level III, .55; and total sample, .33. For the APT-CTMM: Level I, .49; Level II, .61; Level III, .44; and total sample, .41. The data indicates that when considering each composite as a whole, the

TABLE III

Multiple Correlations Between the GATB Composite and Course Grades at Each Iteration for the Four Groupings

Number of Predictors Eliminated	Level I N = 22		Level II N = 35		Level III N = 35		Total N = 92	
	Predictor Eliminated	Multiple R	Predictor Eliminated	Multiple R	Predictor Eliminated	Multiple R	Predictor Eliminated	Multiple R
0	None	.69	None	.64	None	.55	None	.33
1	G	.69	M	.64	P	.55	N	.33
2	P	.69	Q	.63	V	.54	V	.33
3	F	.69	P	.62	G	.54	P	.33
4	M	.68	N	.61	K	.53	Q	.33
5	N	.67	S	.60	F	.52	F	.33
6	V	.65	V	.58	Q	.50	S	.32
7	Q	.61	F	.54	S	.45	K	.31
8	S	.59	K	.42	M	.35	G	.25
Zero-Order Correlation With Most Significant Predictor	K	.59	G	.42	N	.35	M	.25

TABLE IV

Multiple Correlations Between the APT-CTMM Composite and Course Grades at Each Iteration for the Four Groupings

Number of Predictors Eliminated	Level I N = 22		Level II N = 35		Level III N = 35		Total N = 92	
	Predictor Eliminated	Multiple R	Predictor Eliminated	Multiple R	Predictor Eliminated	Multiple R	Predictor Eliminated	Multiple R
0	None	.49	None	.61	None	.44	None	.41
1	Num	.49	Num	.61	CTMM	.44	Lang	.41
2	Lang	.48	Ver	.60	AR	.42	Num	.40
3	Ver	.45	CTMM	.54	Lang	.39	CTMM	.35
4	AR	.39	Lang	.48	Ver	.27	Ver	.33
Zero-Order Correlation With Most Significant Predictor	CTMM	.39	AR	.48	Num	.27	AR	.33

GATB composite yields the higher multiple correlation with the criterion at each of the three levels. For the total sample, however, the APT-CTMM composite yields the higher multiple correlation.

However, because the GATB composite contains nine predictors and the APT-CTMM composite has only five predictors, the GATB can be expected to show higher multiple R's. (Everytime a variable is added the multiple R can be expected to increase.) By looking at only the zero-order correlation with the most significant predictor for each of the four groupings this problem is eliminated. Analyzing the data in this manner produces a correlation which is greater for the GATB at level I (correlation between GATB K and criterion .59) and level III (correlation between GATB N and criterion .35). Zero-order correlation is greater for the APT-CTMM at level II (correlation between APT-CTMM AR and criterion .48) and for the total sample (correlation between APT-CTMM AR and the criterion .33).

Because of the different results obtained from looking at the data in different ways, it was decided to attempt another approach which might be more meaningful than either of the two already considered. In order to accomplish this it was decided to view each composite in terms of the multiple R's yielded by taking the three most significant predictors for each grouping. This approach was selected because it was apparent that the three most significant predictors accounted for almost all of the predictable variance and what remained may well have been due to chance. Table V shows the multiple R's for the three predictor aptitudes that resulted from this analysis.

Question # 1 - Part b

Does the use of the GATB manipulative aptitudes (K, F and M) as predictors increase the validity of the GATB?

TABLE V

Multiple Correlation Between the Three Most Significant Predictors and Course Grades for the GATB Composite, APT-CTMM Composite and the Combined Composite

	GATB		APT-CTMM		GATB and APT-CTMM	
	Three Most Significant Aptitudes	Multiple R	Three Most Significant Aptitudes	Multiple R	Three Most Significant Aptitudes	Multiple R
	1 2 3		1 2 3		1 2 3	
Level I	K, S, Q	.65	CTMM, AR, VER	.48	K, CTMM, VER	.69
Level II	G, K, F	.58	AR, LANG, CTMM	.60	G, LANG, AR	.65
Level III	N, M, S	.50	NUM, VER, LANG	.42	N, G, K	.46
TOTAL	M, G, K	.32	AR, VER, CTMM	.40	AR, M, VER	.41

In an attempt to answer this question it was decided to look again at the three most significant predictors of the GATB for each of the four groupings. The three most significant predictors (aptitudes) are listed as part of Table V. The data shows that the manipulative aptitudes (K) in level I and (M) in the total sample are the most significant predictors in each grouping. For level II and for the total sample two of the three most significant predictors are manipulative aptitudes. Of the twelve most significant predictors for the four groupings, six or one-half are manipulative aptitudes although the manipulative aptitudes comprise only one-third of the battery. Among all of the aptitudes, motor coordination (K), which appears in all but one of the four groupings as one of the three most significant aptitudes, makes the highest contribution in predicting shop achievement.

Question # 1 - Part c

Does the use of the two predictor composites combined (APT-CTMM and GATB) result in an increase in predictive efficiency as compared to using the measures separately?

The results of combining the two predictors appear in Table VI. It becomes apparent by comparing Tables III and IV to Table VI that combining the two composites does yield multiple correlations which are higher than for either of the two composites taken separately. However, in order to justify the use of 14 variables for predicting shop achievement it must be demonstrated that each of the predictors make a significant contribution. Looking at the columns of multiple R's for each grouping, it becomes evident that less than half of the predictors bare even discernible weights in terms of prediction. Also, by looking at Table V and comparing the multiple R's for the three most significant predictors

TABLE VI

Multiple Correlations Between the Combined Composite (GATB and APT-CTMM) and Course Grades at Each Iteration for the Four Groupings.

Number of Predictors Eliminated	Level I N = 22		Level II N = 35		Level III N = 35		Total N = 92	
	Predictor Eliminated	Multiple R	Predictor Eliminated	Multiple R	Predictor Eliminated	Multiple R	Predictor Eliminated	Multiple R
0	None	.79	None	.77	None	.67	None	.46
1	G	.79	CTMM	.77	S	.67	S	.46
2	S	.79	M	.77	P	.67	K	.46
3	Num	.78	Ver	.77	Num	.67	F	.46
4	F	.78	Q	.77	Q	.66	N	.46
5	AR	.78	N	.77	CTMM	.66	Q	.46
6	P	.76	P	.76	F	.65	P	.46
7	Lang	.74	V	.75	M	.64	G	.46
8	V	.73	S	.75	Lang	.62	Lang	.45
9	N	.72	F	.73	V	.58	Num	.45
10	Q	.71	Num	.71	Ver	.56	V	.44
11	M	.69	K	.65	AR	.46	CTMM	.41
12	Ver	.63	AR	.55	K	.40	Ver	.39
13	CTMM	.59	Lang	.42	G	.35	M	.33
Zero-Order Correlation With Most Significant Predictor	K	.59	G	.42	N	.35	AR	.33

in the combined composite with those of each of the composites taken separately, only a slight increase in the multiple correlation is evident. In the case of Level III there is actually a decrease in multiple correlation.

Question # 2

What effect does combining the three groupings (Level I, II, and III) have on both the GATB and the composite APT-CTMM in predicting achievement?

By looking again at Table III for the GATB and Table IV for the APT-CTMM, it is apparent that combining the sample has the effect of lowering the multiple correlation between each composite and the criterion. Considering the total multiple R's, it can be seen that the GATB atains a higher multiple R at each of the levels but drops below the APT-CTMM when the sample is combined. However, because of the difference in the number of predictors in each composite as was pointed out earlier, it was again decided to consider only the three most significant predictors in each composite. Using this approach, the data in Table V shows that there is a much greater reduction in multiple R for the GATB than for the APT-CTMM when the sample was combined.

Caution should be used in making this interpretation because the precision of measurement is not as great when working with the smaller sample numbers in the divided sample. To determine the effect of a larger sample number, the zero-order correlations between the most significant of the predictors and the criterion for each of the groupings were examined using 95% confidence interval. The amount of overlap between confidence interval bands for the total sample and each of the three levels can be compared to determine the effect of sample size on each composite. Table VII shows 95% confidence interval for the zero-order correlation. When combining the three levels for the GATB composite, a loss of predictive validity

TABLE VII

95% Confidence Intervals for the Zero-Order Correlations Between Course Grades and the Most Significant Predictor for Each Level of the Analyses

Category and Level	Most Significant Predictor	Correlation	.00 .10 .20 .30 .40 .50 .60 .70 .80
GATB			
Level I	K	.59	N = 22
Level II	G	.42	N = 35
Level III	N	.35	N = 35
Total	M	.25	N = 92
APT and CTMM			
Level I	CTMM	.39	N = 22
Level II	AR	.48	N = 35
Level III	Num	.27	N = 35
Total	AR	.33	N = 92
COMBINED			
Level I	K	.59	N = 22
Level II	G	.42	N = 35
Level III	N	.35	N = 35
Total	AR	.33	N = 92

is apparent. Comparing the confidence band for the total sample with the confidence bands for each of the levels the amount of overlap ranges from approximately half the total sample band for Level I to complete overlap of bands for Level III. Following the same procedure for the APT-CTMM composite, it is evident that for Level I and III there is complete overlap and at Level II there is approximately 75% overlap. Interpreting these results, it appears that there is greater loss of validity for the GATB composite than for the APT-CTMM composite when the three levels were combined.

SUMMARY AND CONCLUSIONS

This study has attempted to evaluate the usefulness of the GATB in providing valid information to ninth grade students who are considering entrance into the senior high school vocational curriculum. The investigation was prompted by the recent decision of the United States Employment Service to release the GATB for use by qualified school personnel. The study was conducted using a sample of 92 tenth grade boys in the 14 vocational shops in the Altoona Area Vocational-Technical School. The students had been tested with the language part of the CTMM in September, 1965 and the APT in December, 1966. The GATB form B-1002, was administered in April of 1967. the criterion of prediction was a student's shop grade assigned by his instructor at the end of the first semester in the vocational curriculum (January, 1968).

Because of the small number of students from the total sample enrolled in each shop, the 14 shops were combined into three relatively homogeneous groupings. Each of these groupings and the total sample

were analyzed using the GATB composite alone, the APT-CTMM composite alone and the two composites combined. Both multiple correlations and zero-order correlations between the criterion and selected predictors were calculated. The following results were obtained:

1. When the sample was divided into relatively homogeneous groupings the GATB possessed greater validity for predicting shop achievement than did the APT-CTMM composite. When the groupings were combined, the APT-CTMM composite appeared to have more validity for predicting shop achievement than did the GATB.
2. The GATB manipulative aptitudes (K, F and M) made a significant contribution to the validity of the GATB for predicting shop achievement.
3. Using both the GATB and the APT-CTMM combined resulted in very little increase in predictive efficiency as compared to using either measure separately.
4. Combining the three goupings resulted in a loss of validity for predicting shop achievement which was greater for the GATB than for the APT-CTMM composite.

Based on the findings of this study it appears that the GATB does provide useful information for the ninth grade student who is contemplating entrance into the senior high school vocational curriculum. When shop areas were grouped together, the GATB was no better for predicting shop achievement than some of the other measures currently used. However, predicting shop achievement in general may not have any meaning for the student who is making a decision to enter a particular shop. If prediction is restricted to one shop or a group of closely related shops it appears that the GATB possesses predictive validity superior

to the measure currently used. Assuming, then, that the results of this study bear consideration, the GATB is most useful to the counselor in providing some of the information a student needs to choose from among the many vocational shops available to him.

Some comparisons can be made between this study and some of the studies cited in the review of the literature. On the basis of results reported by Samuelson (1956) and Ingersoll and Peters (1966) it appears that multiple correlations of .50 or better using three significant predictors can be considered high when predicting shop grades with the GATB. Foote (1960) using the DAT and several other tests found shop grades the most poorly predicted criterion among the criteria used (multiple R, .25 using two predictors). Droege (1965) using a dichotomized criterion of good and poor grades obtained a multiple R of .38 using four GATB aptitudes. Considering the fact that these studies analyzed each shop separately the multiple correlations obtained in this study are at least as high as could be reasonably anticipated.

It is hoped that this study will provide a stimulation for further studies that will add to the useful information provided by this and previous endeavors. For studies which might follow, it is recommended that each shop in a vocational program be analyzed separately using sufficiently large samples. It may also be recommended that for the purpose of comparing the predictive value of the GATB with the predictive value of some other measure that both predictors be administered at about the same time. It should be considered that both the type of skills to be learned as well as individual student's aptitudes may change between the student's first semester in a training program and the time he takes his first job. For this reason, longitudinal studies

should be undertaken which could include prediction of first and third year performance as well as success on the job.

Possible studies which might be undertaken could evaluate the GATB as compared to other aptitude measures currently in common use such as the DAT. From the findings of this study, it can be hypothesized that the GATB is superior to other aptitude measures in predicting shop achievement because it contains manipulative as well as cognitive aptitudes. Its value to counselors may thus lie in its ability to assess youngster's potential motor skill development.

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